**BOILER**

Boilers or Steam generators are used to generate steam at desired rate and desired pressure and temperature by burning fuel in its furnace. They can be classified as fire tube or water tube boilers depending on whether the hot gas or water is present in the tubes inside the boiler.

**Fire Tube Boilers**

Earlier designs include fire tube boilers suitable for small steam requirements. They can be externally fired or internally fired. The externally fired is the one in which furnace is outside the boiler shell. The products of combustion flow through the tubes which are immersed in a shell containing water As the flue gases flow through the tubes, heat is transferred from gas to water and water is converted to steam. In internally fired fire tube boiler, the furnace is present inside the shell containing water. Combustion gases flow through the pipes and let out to the atmosphere. These gases exchange the heat with the water present in the shell. The major shortcoming of fire tube boiler is that the pressure limitations are inherent in its basic design. The steam present in the drum exerts hoop stress on the shell and larger the shell, larger is the stresses induced and to increase the pressure carrying capacity, the thickness has to be increased which increases the manufacturing cost.

**Water Tube Boilers**

Modern boilers are mostly water tube boilers. These were developed to permit increases in boiler capacity with reasonable metal stresses. Since water tube boilers have water flowing in small tubes, the pressure carrying capacity of the tubes being higher, they are used to generate high pressure steam. The water tube boilers can be further divided as straight tube or bent tube boilers.

**Modern Boilers**

Figure shows a typical configuration of a modern boiler. The main parts of a boiler are Economizer, Boiler Drum, Water Walls, Furnace, Convective Superheater, Radiant Superheater, Pendant Superheater, Desuperheater, Reheaters, FD Fan, ID Fan, Electrostatic Precipitator,Air Preheater.

**Economizer** is the first step in the steam generation process. The feed water from the boiler feed pump enters the economizer where it is heated by the hot flue gases. The hot flue gases leave burner and travel through the furnace to the chimney and exchanges its heat from different heat exchangers in its way to the exhaust chimneys.

After getting saturated, the feed water is taken to the **Boiler drum**. The purpose of boiler drum is to evaporate the feed water or provide latent heat. The saturated water from the boiler drum comes down via **Downcommers** and is then passed through **water walls (Risers)** which are number of evaporation tubes spaced all around the walls of the furnace and is used to take away the latent heat using the heat exchange from the hot flue gases. The flow of the feed water can be natural circulation by the density difference between the water in the riser and downcommers or when the pressure is higher, the circulation pump is used to provide the flow as the density difference is not enough to cause natural circulation. The mixture of saturated liquid and steam then enters again to boiler drum where the steam and the liquid are separated and the steam goes to the superheaters.

A **Superheater** is a heat exchanger in which heat is transferred in a saturated steam to increase its temperature to the desired value. In modern boilers, more than 40% of the heat absorption takes place in superheaters. Superheaters are commonly classified as either convective, radiant or pendant supreheaters. The **Convective superheaters** are often termed as primary superheaters where the saturated steam from the drum is admitted. After passing through the convective superheater, the steam proceeds to the **Radiant superheaters** where the heat exchange between the flue gases and the steam is mostly due to radiation. As the heat exchange is due to radiation, the amount of temperature increase is generally more than what is required so the steam is desuperheated in **Desuperheaters**. The desuperheater is a direct contact type and the tapping from the boiler feed water is taken and sprayed over the steam to desuperheat it. The steam is then passed to **Pendant superheater** where the steam is finally heated to the desired temperature. There heat is transferred partly by convection and partly by radiation.

The flue gases are produced in the burners by burning the mixture of gases and preheated air. The gases contain mixture of BF (Blast Furnace gas), CO (Coke oven) gas, LDO (Light diesel oil) gas. The air is preheated using the **Air Preheater.** The air is sucked through the **Forced Draught** fan and then passed through the Air Preheater where the heat exchange takes place between the flue gases and the air.

The flue gases after passing through the air perheater then passes through the **Electrostatic Precipitator** where the dust particles are precipitated and the **Induced Draught** Fan then takes it to the atmosphere via **chimneys.**











